Impacts of Residential and Environmental Factors on Community Responses to Transportation Noise in Vietnam

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The data from aircraft and road traffic noise surveys conducted in Hanoi and Ho Chi Minh City were re-analyzed to investigate whether residential and environmental factors influence noise annoyance and activity disturbances. The multiple logistic regression analysis was applied with personal and residential environmental factors such as age, gender, satisfaction with residential area, comfort in rainy season, greenery in residential area, quietness of residential area, and so on as the independent variables and noise annoyance as the dependent variable. The results showed that annoyance caused by road traffic was significantly affected by the satisfaction with residential area, the comfort in rainy season and quietness of residential area, while aircraft noise annoyance wasn't significantly influenced by these variables except the satisfaction withthe residential area. The quality of sleep was affected by the satisfaction withthe residential area and the presence of greenery with the areas along the roads but was not affected in areas exposed by aircraft noise. In areas with combined noises, the satisfaction withthe residential area affected the quality of sleep of the residents.

1. INTRODUCTION

In recent years, it has been discussed concerning to annoyance and sleep disturbance caused by transportation noise in European nations in conformity with the report [1] and the Environmental Noise Directive 2002 [2]. Babisch et al. [3] investigated the relation between annoyance and noise exposure (Lden and Lnight) at 6 major European airports, and there was no difference between their results and the EU curve for road traffic noise. The annoyance caused by aircraft noise was higher than that predicted by the EU standard curves in the HYENA study, and it was proposed that the current EU prediction curve for aircraft noise annoyance be modified.Airplanes fly not only over European countries but also all over other countries throughout the world, the establishment of noise policy in Asian countries also needs to take the results of European research into consideration, and also needs to indicate the results of Asian research.

The authors have been conducting a social survey of transportation noise in Vietnam since 2005 [4-6]. Vietnam is a developing country, and it has the second largest population in Southeast Asia. It is currently facing many environmental issues such as air, water and noise pollution, especially in large cities like Hanoi and Ho Chi Minh City. Social surveys of community response to road traffic noise in Hanoi and Ho Chi Minh City were conducted in 2005 and 2007, respectively [4]. These surveys indicated the first dose-response relationships

between Lden and the percentage of highly annoyed in Vietnam. Nguyen et al. [5, 6] carried out social surveys on aircraft noise in Hanoi and Ho Chi Minh City, 2009 and 2008, respectively. These studies showed that the dose-response curve for aircraft noise annoyance fit the EU curve in Ho Chi Minh City's data, while the curve in Hanoi's data was slightly higher than the EU curve.The objective of the present study is to assess whether residential environmental factors affect noise annoyance and sleep disturbances usingmultiple logistic analysis in Vietnam's socio-acoustic data.

2. METHOD

Data

Social surveys on community response to road traffic and aircraft noises were conducted in Hanoi and Ho Chi Minh City with the interview method from 2005 and 2009.The sample sizes were from 549 to 1437. The number of males and females was almost the same in all surveys. More than half of the respondents were between ages of 20 and 39.

The road traffic in their survey had the following characteristics motorbike accounted for around 90 percent of the volume of traffic and many horn sounds were included in this noise. Road traffic noise levels on the most-exposed side of the dwelling were estimated by the 24-hour noise measurement values and the distance reduction equations based on the short-term measurement by using sound level meters.The range of noise exposure levels was 62 to 76 dB at Lnight, and 70 to 83 dB at Lden. The combined noise of aircraft and road traffic was measured every one second for 24h on the road shoulder. Aircraft noise exposure was measured every one second for seven successive days by using sound level meters at the same site. Aircraft and combined noise exposures ranged from 48 to 71 dB and from 70 to 83 dB at Lden, respectively.

Annoyance and sleep disturbance

Noise annoyance was measured on the ICBEN standardized 5-point verbal scale and 11-point numerical scale [7,8]. Sleep disturbances were also measured according to the recommendation of the ICBEN standardized 5-point verbal scale.

Statistical analysis

A multiple logistic regression analysis was performed to calculate adjusted odds ratios for the percentage of individuals highly annoyed or experiencing high sleep disturbance, as well as for residential environmental factors in relation to relevant independent variables. These independent variables were categorized between the top 2 categories ("extremely" and "very") and the other three categories. In this paper, residential environmental variables capture the satisfaction with a residential area, its comfort level in the rainy season, the greenery in the residential area, and the quietness of the residential area. SPSS version 11.0 was used for the analysis.

3. RESULTS

Annoyance

Table 1shows odds ratios of residential environmental variables for noise annoyance. The odds ratios of the satisfaction with the residential area, with respect to road traffic and aircraft noise, were 1.924 and 2.678, respectively. Thus, it was confirmed that people who did not satisfy residential areas indicated a high noise annoyance. Furthermore, with respect to road traffic noise, the odds ratios of the comfort level during the rainy season and the quietness of the residential area for noise annoyance were significantly. In contrast, no significant relationship was observed between the greenery in the residential area and the annoyance caused by road traffic or aircraft noise. Li et al. [9] indicated that greenery perception exerts considerable influence on road traffic noise annoyance ratings, at home. And also, Gidlöf-Gunnarsson et al. [10] showed the having

access to green area with a sound environmentthat was perceived as “good” significantly reduces noise annoyance in road traffic noise. As such, it will be necessary to examine whether the same result is obtained in our next study.

Sleep disturbance

This paragraph shows that the result from the multiple logistic regression analysis between activity disturbance and residential environmental variables. The result of our analysis of whether sleep disturbance is influenced by the residential environmental variables is presented in Table 1. The odds ratios associated with people who do not satisfy residential areas increased with sleep disturbance, when dealing with road traffic and combined noises. In contrast, it had no significant influence with aircraft noise. The relationship between the greenery in the residential area and sleep quality was significant (p<0.05). It was found that people who respond severely with respect to comfort in the rainy season and the quietness of the residential area tended to have slightly high odds ratio, but this was not significant in any of the three noise environments. Öhrström [11] showed that the sleep disturbance of people who had a quiet side in their house was lower than those who did not, when dealing with road traffic noise. The benefit of access to a quiet side for sleep ranged from 8% to 18%. Further study and analysis are needed to gain a better understanding of sleep disturbance.

4. CONCLUSIONS

In this paper, we presented the results of an examination of whether person-related and residential environmental variables would influence the relationship between transportation noise and noise annoyance, as well as sleep disturbance in Hanoi and Ho Chi Minh City, Vietnam.With respect to road traffic noise, it was shown that these three residential environmental variables (the satisfaction with the residential area, the comfort level in the residential area and the quietness of the residential area) influence noise annoyance. On the other hand, although it was shown that the satisfaction with a residential area influences noise annoyance with respect to aircraft noise, the influence of other variables was not observed.The sleep disturbance caused by road traffic and combined noises was affected by the satisfaction with the residential area but no influence was shown with that by aircraft noise. The presence of greenery with the areas along the roads also influenced the quality of sleep.

5. REFERENCES

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Table 1. Odds ratio of residential environmental variables[1] for noise annoyance[2]

	Odds ratio (95% Confidence Interval)		
	Road traffic noise	Combined noise	Aircraft noise
(a) Noise annoyance			
Satisfaction	1.924(1.038-3.567)*	1.265(0.624-2.566)	2.678(1.271-5.641)***
Comfort	2.039(1.508-2.758)***	1.000(0.635-1.573)	1.215(0.835-1.767)
Greenery	1.115(0.872-1.427)	1.169(0.787-1.737)	1.177(0.806-1.720)
Quietness	3.947(3.096-5.031)***	2.736(1.840-4.068)***	1.379(0.923-2.059)
Lden	1.056(1.005-1.109)*	1.172(1.108-1.240)***	1.179(1.136-1.223)***
Constant	0.000***	0.000***	0.000***
(b) Sleep quality			
Satisfaction	3.696(2.463-5.545)***	4.964(2.557-9.636)***	1.937(0.939-3.997)
Comfort	0.814(0.597-1.110)	1.094(0.651-1.836)	1.366(0.883-2.113)
Greenery	1.425(1.056-1.923)*	0.928(0.566-1.522)	1.303(0.827-2.055)
Quietness	1.061(0.756-1.488)	1.580(0.948-2.630)	1.570(0.995-2.475)
Lnight	0.997(0.942-1.055)	1.079(1.013-1.149)*	0.989(0.946-1.035)
Constant	0.002**	0.000***	0.019**

[1] Independent variables included in model: age, gender, area (Hanoi and Ho Chi Minh), self-reported noise sensitivity, frequency of use of transport, attitudeto noise sources, safety image of noise sources, and actual time spent in the house and area.
[2] Dependent variable: High levels of noise annoyance and sleep disturbance were created by merging "very" and "extremely" annoyed categories.
*:$p<0.05$, **:$p<0.01$, ***: $p<0.001$